High-Speed, Depth-Resolved Images of Cardiac Electrophysiology: HL69097-01

Guy Salama P.I., Bum-Rak Choi University of Pittsburgh
Alan Waggoner, Lauren Ernst and Fred Lanni Carnegie Mellon University

Aim 1 Build a 3-D imaging system for large fields-of-view (0.3x0.3cm^2) that will be used to map action potentials (APs) or intracellular Ca^{2+} transients (Cai) from intact hearts, during sinus rhythm and arrhythmias.

Aim 2: Synthesize new long wavelength fluorescent voltage sensitive dyes to map APs, test the spectral and response characteristics of new dyes in hearts.

Aim 3: From 3-D maps of electrical activity, depth-resolved maps of activation, repolarization and AP durations will be used to investigate fundamental concepts in cardiac electrophysiology:

A) Electrical coupling (time-delay or block) between Purkinje fibers (**P**), Transitional (**T**) and Ventricular (**V**) cells will be mapped in 3-D to elucidate the **role of PV junctions** in the initiation and maintenance of arrhythmias.

B) Impulse propagation across the atrio-ventricular node (AVN) in 3-D will reveal the precise mechanisms of AV delay, inputs to the node (fast and slow pathways), mechanisms of AVN reentry, and Wolf-Parkinson syndrome.

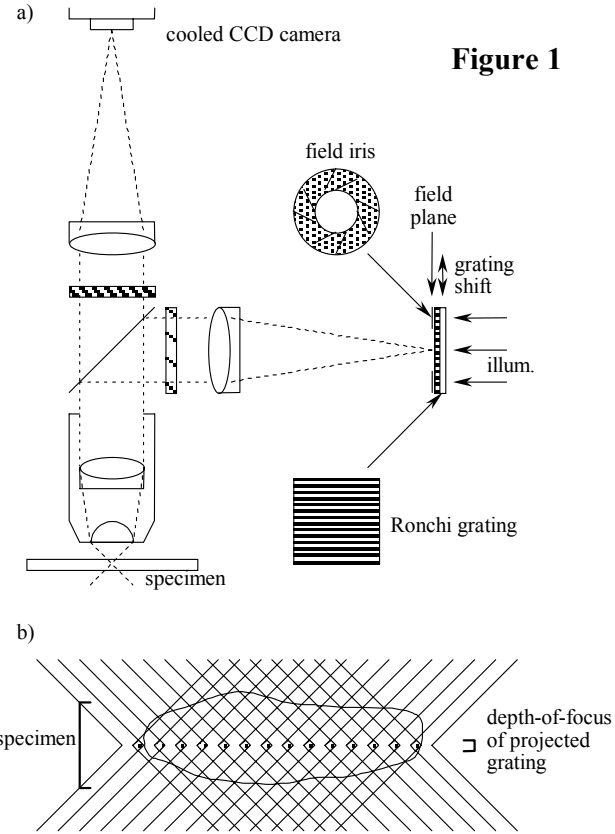

Figure 1

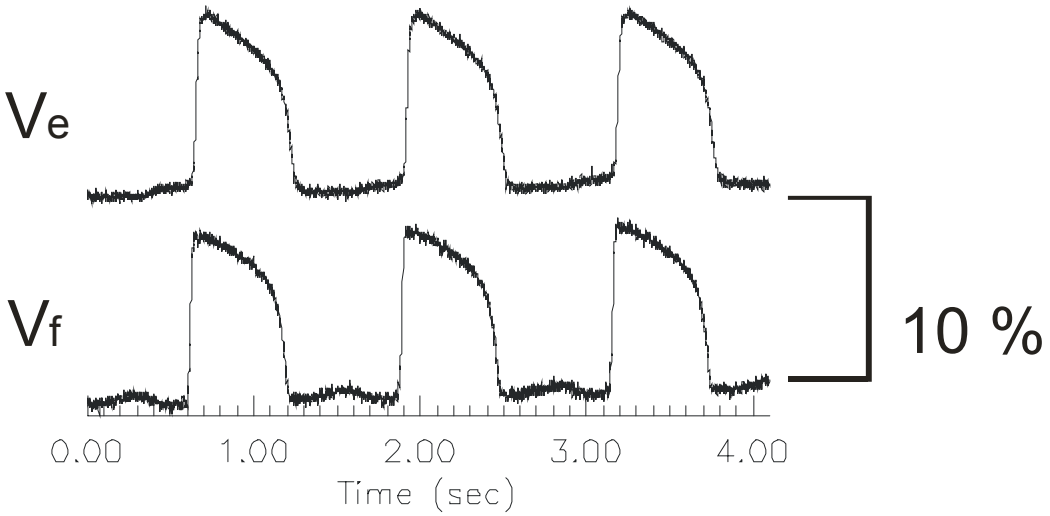

Fig. 2 Simultaneous recordings of APs using a microelectrode (Ve) and the fluorescence of dye (Vf) PGH1; λex = 690 ± 30 nm; λem > 780 nm, peak at 856 nm.

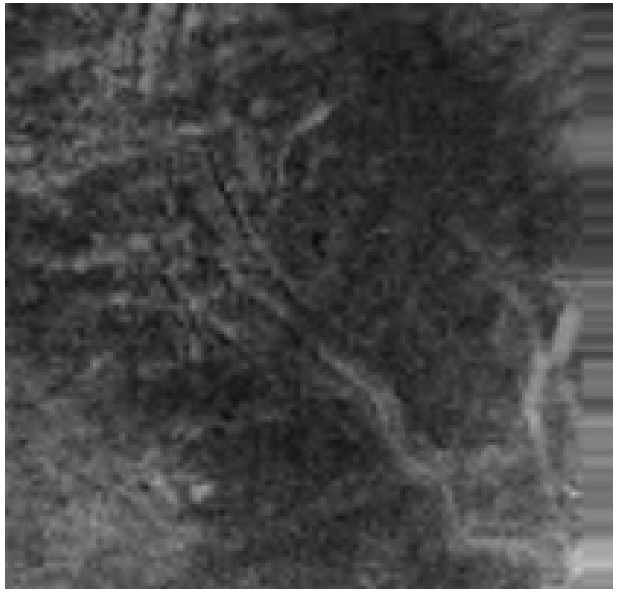

Fig. 3
AP Propagation (10K f/s)

CMOS Image of a guinea pig heart
100x100 μm^2
0.1 ms sampling